What Is Claimed Is:

1. A communication apparatus which:

is connected with a network comprising

(i) lower-layer apparatuses which are connected with communication lines of a lower layer and communication lines of an upper layer and have means for line switching in the lower layer, and

(ii) upper-layer apparatuses which are connected with the communication lines of the upper layer and have means for line switching in the upper layer; and

detects line failure and coordinates line switching by the line-switching means of the lower- and upper-layer apparatuses by using failure information on the lower- and upper-layer communication lines.

2. A communication apparatus according to claim 1 wherein each lower-layer apparatus has a coordinated-switching device or a coordinated-switching function or is connected with coordinated-switching means through an interface.

3. A communication apparatus according to claim 1 having a switching mode that the line-switching means of the upper-layer apparatuses begin switching when the line-

switching means of the lower-layer apparatuses have finished switching.

4. A communication apparatus which:

is connected with a network comprising

(i) lower-layer apparatuses which are connected with communication lines of a lower layer and communication lines of an upper layer and have means for line switching in the lower layer, and

(ii) upper-layer apparatuses which are connected with the communication lines of the upper layer and have means for line switching in the upper layer; and

has means for

(i) detecting line failure and determining the order of switching by the switching means of the lower- and upper-layer apparatuses by using failure information on the lower- and upper-layer communication lines, and

(ii) restoring faulty communication lines.

5. A communication apparatus which:

is connected with a network comprising

(i) lower-layer apparatuses which are connected with communication lines of a lower layer and communication lines of an upper layer and have means for line switching in the lower layer, and

(ii) upper-layer apparatuses which are connected with the communication lines of the upper layer and have means for line switching in the upper layer;

detects line failure and collects failure information on the lower- and upper-layer communication lines;

identifies one or more faulty lines of the lower or the upper layer and locates the site of occurrence of failure by using the collected failure information;

identifies, by using the information on the faulty communication lines and the site of occurrence of failure, lower- and upper-layer apparatuses which are required to make line switching in order to restore the faulty communication lines; and

has means for determining the order and the timing of line switching by the line-switching means of the identified lower- and upper-layer apparatuses.

6. A communication apparatus which:

is connected with a network comprising

(i) lower-layer apparatuses which are connected with communication lines of a lower layer and communication lines of an upper layer and have means for line switching in the lower layer, and

(ii) upper-layer apparatuses which are connected with the communication lines of the upper layer and have means for line switching in the upper layer;

transmits a switching-inhibit signal to the upper-layer apparatuses when any lower-layer apparatus has detected line failure;

identifies faulty lines of the lower and upper layers and locates the site of occurrence of failure by using failure information collected on the lower- and upper-layer communication lines; and

coordinates line switching by the lower- and upper-layer apparatuses by using said collected failure information on the lower- and upper-layer communication lines.

7. A communication apparatus which:

is connected with a network comprising

(i) lower-layer apparatuses which are connected with communication lines of a lower layer and communication lines of an upper layer and have means for line switching in the lower layer, and

(ii) upper-layer apparatuses which are connected with the communication lines of the upper layer and have means for line switching in the upper layer;

transmits a switching-inhibit signal to the upper-layer apparatuses when any lower-layer apparatus has detected line failure;

identifies one or more faulty lines of the lower or the upper layer and locates the site of occurrence of failure by using failure information collected on the lower- and upper-layer communication lines;

cancels the switching-inhibit signal to the upper-layer apparatuses when no lower-layer communication line has been found faulty but any of the upper-layer communication lines has been found faulty;

determines, by using failure information on the lower- and upper-layer communication lines, which line-switching means of the lower- and upper-layer apparatuses should make switching in order to secure a largest number of normal upper-layer communication lines, or in order to restore high-priority lines rather than low-priority lines, or in order to secure a largest number of signal channels, in case that any of the lower-layer communication lines has been found faulty; and

has means for causing line switching in the lower layer first and then canceling the switching-inhibit signal to the upper-layer apparatuses in case that switching is to take place in both the lower and upper layers in accordance with said determination.

8. A communication system wherein:

provided are a first and a second upper-layer apparatus and a first, a second, a third, and a fourth lower-layer apparatus, each apparatus having line-switching means;

(i) the first and second upper-layer apparatuses are connected to each other through a first and a second upper-layer communication line between which communication can be switched, (ii) the first and second lower-layer apparatuses are connected to each other through a first and a second lower-layer communication line between which communication can be switched, each lower-layer communication line being multiplexed to accommodate one or more upper-layer communication lines, (iii) the third and fourth lower-layer apparatuses are connected to each other through a third and a fourth lower-layer communication line between which communication can be switched, each lower-layer communication line being multiplexed to accommodate one or more upper-layer communication lines, (iv) the first upper-layer communication line connects the first upper-layer apparatus with the first lower-layer apparatus and the second upper-layer apparatus with the second lower-layer apparatus, and (v) the second upper-layer communication line connects the first upper-layer apparatus with the third

lower-layer apparatus and the second upper-layer apparatus with the fourth lower-layer apparatus;

a switching-inhibit signal is transmitted to the upper-layer apparatuses when the lower-layer apparatuses have detected line failure;

one or more faulty lines of the lower or the upper layer are identified and the site of occurrence of failure is located by using failure information on the lower- and upper-layer communication lines;

the switching-inhibit signal to the upper-layer apparatuses is cancelled when no lower-layer communication line has been found faulty but any of the upper-layer communication lines has been found faulty;

which line-switching means of the lower- and upper-layer apparatuses should make switching is determined, based on failure information on the lower- and upper-layer communication lines, in order to secure a largest number of normal upper-layer communication lines, or in order to restore high-priority lines rather than low-priority lines, or in order to secure a largest number of signal channels, in case that any of the lower-layer communication lines has been found faulty; and

provided is a first means for causing line switching in the lower layer first and then canceling the switching-inhibit signal to the upper-layer apparatuses, in

case that switching is to take place in both the lower and upper layers in accordance with said determination.

9. A communication system according to claim 8 wherein said first means:

chooses a set of the line-switching means which has the smallest number of times of switching if two or more sets of line-switching means are found to bring about one and the same result for the proposition of securing a largest number of normal upper-layer communication lines, restoring high-priority lines rather than low-priority lines, or securing a largest number of signal channels;

chooses a set of line-switching means requiring no line switching in the lower layer, if any, and the switching-inhibit signal to the upper-layer apparatuses is cancelled if two or more sets of line-switching means are found to have one and the same smallest number of times of switching; and

causes line switching in the lower layer first and then cancels the switching-inhibit signal to the upper-layer apparatuses if there is not a set of line-switching means which requires no line switching in the lower layer.

10. A communication system wherein:

a plurality of lower-layer apparatuses and a plurality of upper-layer apparatuses are provided, the latter belonging to a layer which is upper than a layer to which the former belong, each apparatus having line-switching means;

connected between the lower-layer apparatuses are lower-layer communication lines, each lower-layer communication line being multiplexed to accommodate one or more upper-layer communication lines, and connected between the upper-layer apparatuses are upper-layer communication lines going through the lower-layer apparatuses;

a switching-inhibit signal is transmitted to the upper-layer apparatuses when any of the lower-layer apparatuses has detected line failure;

one or more faulty lines of the lower or the upper layer are identified and the site of occurrence of failure is located based on failure information on the lower- and upper-layer communication lines;

the switching-inhibit signal to the upper-layer apparatuses is cancelled when no lower-layer communication line has been found faulty but any of the upper-layer communication lines has been found faulty;

which line-switching means of the lower- and upper-layer apparatuses should make switching is determined, based on failure information on the lower- and

upper-layer communication lines, in order to secure a largest number of normal upper-layer communication lines, or in order to restore high-priority lines rather than low-priority lines, or in order to secure a largest number of signal channels, in case that any of the lower-layer communication lines has been found faulty; and

provided is a first means for causing line switching in the lower layer first and then canceling the switching-inhibit signal to the upper-layer apparatuses, in case that switching is to take place in both the lower and upper layers in accordance with said determination.

11. A communication system wherein:

provided are a first and a second upper-layer apparatus and a first, a second, a third, and a fourth lower-layer apparatus, each apparatus having line-switching means;

(i) the first and second upper-layer apparatuses are connected to each other through a first and a second upper-layer communication line between which communication can be switched, (ii) the first and second lower-layer apparatuses are connected to each other through a first and a second lower-layer communication line between which communication can be switched, each lower-layer communication line being multiplexed to accommodate one or

more upper-layer communication lines, (iii) the third and fourth lower-layer apparatuses are connected to each other through a third and a fourth lower-layer communication line between which communication can be switched, each lower-layer communication line being multiplexed to accommodate one or more upper-layer communication lines, (iv) the first upper-layer communication line connects the first upper-layer apparatus with the first lower-layer apparatus and the second upper-layer apparatus with the second lower-layer apparatus, and (v) the second upper-layer communication line connects the first upper-layer apparatus with the third lower-layer apparatus and the second upper-layer apparatus with the fourth lower-layer apparatus;

a switching-inhibit signal is transmitted to the upper-layer apparatuses when the lower-layer apparatuses have detected line failure;

faulty lines of the lower and upper layers are identified and the site of occurrence of failure is located based on failure information on the lower- and upper-layer communication lines;

the switching-inhibit signal to the upper-layer apparatuses is cancelled when no lower-layer communication line has been found faulty but any of the upper-layer communication lines has been found faulty; and

provided is a first means for determining, based on failure information on the lower- and upper-layer communication lines, which line-switching means of the lower- and upper-layer apparatuses should make switching in order to secure a largest number of normal upper-layer communication lines, or in order to restore high-priority lines rather than low-priority lines, or in order to secure a largest number of signal channels, in case that any of the lower-layer communication lines has been found faulty.

12. A communication system wherein:

a plurality of lower-layer apparatuses and a plurality of upper-layer apparatuses are provided, the latter belonging to a layer which is upper than a layer to which the former belong, each apparatus having line-switching means;

connected between the lower-layer apparatuses are lower-layer communication lines, each lower-layer communication line being multiplexed to accommodate one or more upper-layer communication lines, and connected between the upper-layer apparatuses are upper-layer communication lines going through the lower-layer apparatuses;

a switching-inhibit signal is transmitted to the upper-layer apparatuses when any of the lower-layer apparatuses has detected line failure;

one or more faulty lines of the lower or the upper layer are identified and the site of occurrence of failure is located based on failure information on the lower- and upper-layer communication lines;

the switching-inhibit signal to the upper-layer apparatuses is cancelled when no lower-layer communication line has been found faulty but any of the upper-layer communication lines has been found faulty; and

provided is a first means for determining, based on failure information on the lower- and upper-layer communication lines, which line-switching means of the lower- and upper-layer apparatuses should make switching in order to secure a largest number of normal upper-layer communication lines, or in order to restore high-priority lines rather than low-priority lines, or in order to secure a largest number of signal channels, in case that any of the lower-layer communication lines has been found faulty.

13. A communication apparatus which:

is connected with a network comprising

(i) lower-layer apparatuses which are connected with communication lines of a lower layer and communication lines of an upper layer and have means for line switching in the lower layer, and

(ii) upper-layer apparatuses which are connected with the communication lines of the upper layer and have means for line switching in the upper layer; and

has means for giving an instruction to relevant upper-layer apparatuses in case that line failure can not partly or wholly be made good by line switching of relevant lower-layer apparatuses, the instruction requiring said relevant upper-layer apparatuses to make line switching to bypasses going around said relevant lower-layer apparatuses.

14. A communication apparatus which:

is connected with a network comprising

(i) lower-layer apparatuses which are connected with communication lines of a lower layer and communication lines of an upper layer and have means for line switching in the lower layer, and

(ii) upper-layer apparatuses which are connected with the communication lines of the upper layer and have means for line switching in the upper layer;

detects line failure and finds one or more faulty lines of the upper- or the lower-layer communication lines and the site of occurrence of failure based on failure information on the upper- and lower-layer communication lines;

determines which upper- and lower-layer apparatuses should make line switching based on said information on faulty lines and the site of occurrence of failure and information on whether or not there are bypasses going around faulty lower-layer apparatuses, if any; and

has means for giving an instruction to the relevant upper-layer apparatuses, in case that line failure can not partly or wholly be made good by line switching of relevant lower-layer apparatuses and there are bypasses going around said relevant lower-layer apparatuses, the instruction requiring said relevant upper-layer apparatuses to make line switching to said bypasses.

15. A communication apparatus according to claim 14 wherein said failure information on the upper-layer communication lines is collected from at least one of the upper-layer apparatus group and the lower-layer apparatus group.

16. A communication apparatus according to claim 14 wherein said instruction is to cancel the switching-inhibit signal to the upper-layer apparatuses.

17. A communication apparatus which:

is connected with a network comprising

(i) lower-layer apparatuses which are connected with communication lines of a lower layer and communication lines of an upper layer and have means for line switching in the lower layer, and

(ii) upper-layer apparatuses which are connected with the communication lines of the upper layer and have means for line switching in the upper layer;

detects line failure and, at the same time, finds one or more faulty lines of the upper- or the lower-layer communication lines and the site of occurrence of failure by using information on whether bypasses going around particular lower-layer apparatuses can be secured or not by line switching of relevant upper-layer apparatuses and failure information on the upper- and lower-layer communication lines;

determines which upper- and lower-layer apparatuses should make line switching based on said information on faulty lines and the site of occurrence of failure; and

has means for instructing the upper- and lower-layer apparatuses to make line switching in the lower layer first and then make line switching in the upper layer in case that line switching is required in both the upper and lower layers.

18. A communication system comprising:

(i) lower-layer apparatuses which are connected with communication lines of a lower layer and communication lines of an upper layer and have means for line switching in the lower layer and (ii) upper-layer apparatuses which are connected with the communication lines of the upper layer and have means for line switching in the upper layer; and

means for giving an instruction to relevant upper-layer apparatuses in case that line failure can not partly or wholly be made good by line switching of relevant lower-layer apparatuses, the instruction requiring said relevant upper-layer apparatuses to make line switching to bypasses going around said relevant lower-layer apparatuses.

19. A communication system which:

has (i) lower-layer apparatuses which are connected with communication lines of a lower layer and communication lines of an upper layer and have means for line switching in the lower layer, and (ii) upper-layer apparatuses which are connected with the communication lines of the upper layer and have means for line switching in the upper layer;

detects line failure and finds one or more faulty lines of the upper- or the lower-layer communication lines and the site of occurrence of failure based on failure

information on the upper- and lower-layer communication lines;

determines which upper- and lower-layer apparatuses should make line switching based on said information on faulty lines and the site of occurrence of failure and information on whether or not there are bypasses going around faulty lower-layer apparatuses, if any; and

has means for giving an instruction to relevant upper-layer apparatuses, in case that line failure can not partly or wholly be made good by line switching of relevant lower-layer apparatuses and there are bypasses going around said relevant lower-layer apparatuses, the instruction requiring said relevant upper-layer apparatuses to make line switching to said bypasses.

20. A communication system which:

has (i) lower-layer apparatuses which are connected with communication lines of a lower layer and communication lines of an upper layer and have means for line switching in the lower layer, and (ii) upper-layer apparatuses which are connected with the communication lines of the upper layer and have means for line switching in the upper layer;

detects line failure and, at the same time, finds one or more faulty lines of the upper- or the lower-layer communication lines and the site of occurrence of failure

by using information on whether bypasses going around particular lower-layer apparatuses can be secured or not by line switching of relevant upper-layer apparatuses and failure information on the upper- and lower-layer communication lines;

determines which upper- and lower-layer apparatuses should make line switching based on said information on faulty lines and the site of occurrence of failure; and

has means for instructing the upper- and lower-layer apparatuses to make line switching in the lower layer first and then make line switching in the upper layer in case that line switching is required in both the upper and lower layers.